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(54) Apparatus for circulating fluid

(57) Apparatus (1) for circulating fluid in a borehole comprises a body member (2) having a fluid outlet (8). An isolation sleeve (9) is movably mounted on the body member (2) for movement between an open position in which fluid may flow out of the outlet (8) and a closed position. The isolation sleeve (9) is moved to its open position against the action of spring 10 by engaging shoulder 20 with the top of the lining and setting down on the tubing string. In a second embodiment (not shown) the outlet is opened when the lower end of the tubing string engages the bottom of the borehole.

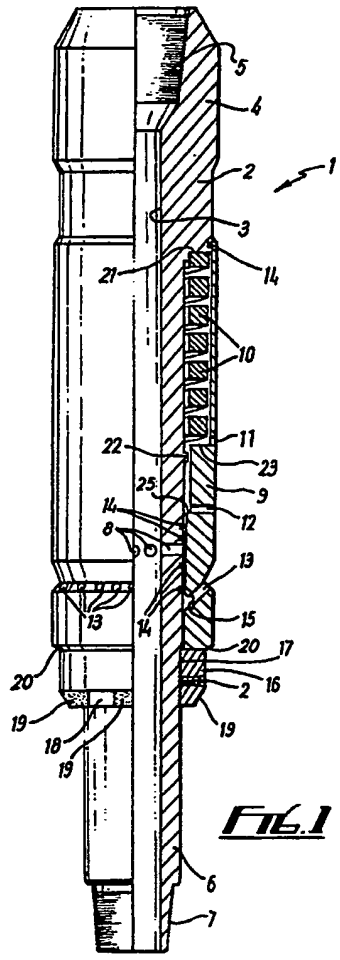

FIG.1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

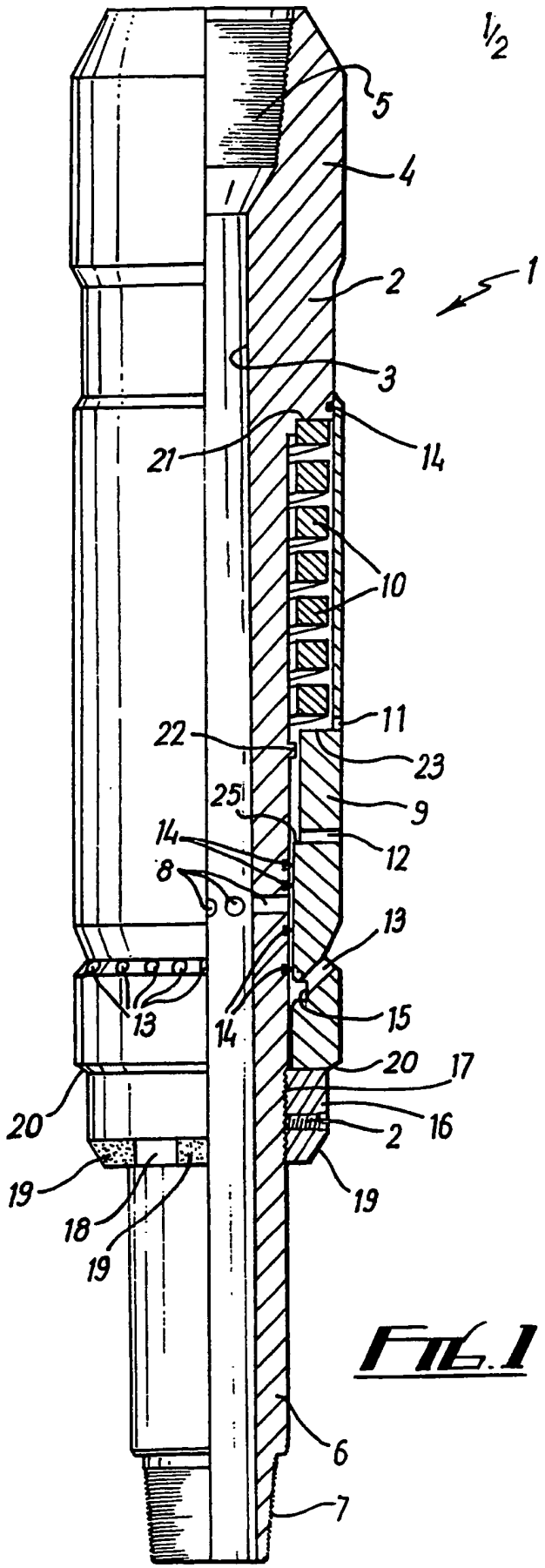
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FIG. 1

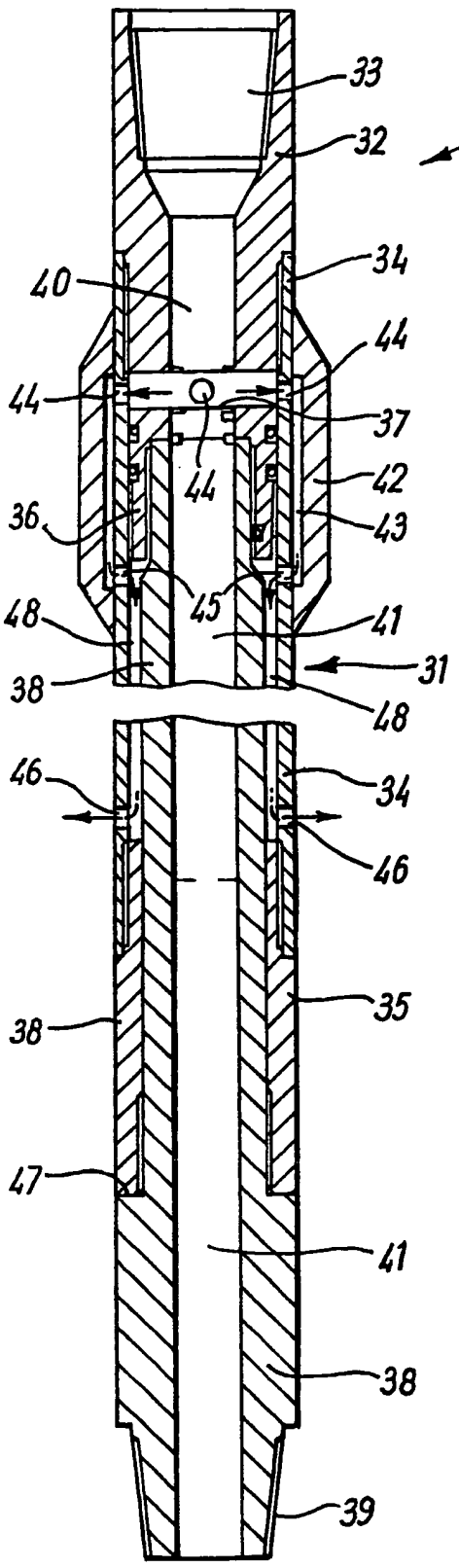
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FIG.2

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"Apparatus for Circulating Fluid"

The invention relates to apparatus for circulating fluid and in particular, apparatus for circulating fluid in a borehole.

It is common practice to install liners within a borehole which has been drilled and after installation of the liners it is generally necessary to clean out the inside of the liner to wash away any debris or other contaminants.

Generally, the liner is in the form of a cylindrical tube which has a relatively small internal diameter compared with the diameter of casing lining the borehole immediately above the liner. To effectively clean out inside the liner, high flow rates are generally required to create turbulence to aid the cleaning out process. Generally, the clean out procedure is carried out by first passing cleaning liquid through the drill string to the lower end of the liner at a high flow rate so that the cleaning fluid flows turbulently up the annulus between the inside of the liner and the outside of the drill-pipe and then into the casing above the liner.

However, because of the difference in volume between the liner and the casing above the liner, after the cleaning fluid passes the top of the liner and enters the relatively large volume of the casing, the flow rate of the cleaning fluid in the casing above the liner is greatly reduced and any cleaning action becomes negligible.

Hence, it is generally necessary after passing cleaning fluid through the liner to then pass further cleaning fluid from the drill-pipe into the casing at a location above or adjacent the top edge of the liner, so that a high flow rate and hence turbulence of the cleaning fluid can be obtained in the casing. Therefore it is generally necessary to have some device at or adjacent to the top end of the liner which can be operated downhole to either circulate fluid through the length of the drill string to the lower end of the liner or which can direct cleaning fluid at high flow rates out of the drill string into the casing above the liner, at or adjacent the top edge of the liner.

Once such device that is known for carrying out this operation comprises a hollow body member and in order to change the direction of flow between the bottom of the liner and the top edge of the liner, spherical balls are dropped down the drill-string to open or close valves in the device.

However, there are a number of disadvantages associated with this apparatus. In particular, the length of time associated with the spherical balls falling from the surface to the device through a drill-string which is perhaps a few thousand feet in length can take 25 to 30 minutes. Hence, there is a problem with co-ordinating

the arrival of the spherical ball at the apparatus to coincide with the arrival of the required cleaning fluid at the apparatus. It is also necessary to ensure that the increasing and decreasing flow rates associated with the liner and the casing clean out are co-ordinated with the arrival of the spherical ball at the apparatus.

In addition, it is generally necessary to repeat the cleaning out of the liner and the casing a number of times with different cleaning fluids until a situation is obtained in which the last clean out is carried out with sea water. Hence, it is necessary to be able to repeatedly operate the apparatus to divert flow between the lower end and upper end of the liner a number of times. With the apparatus described above there is the disadvantage that the apparatus is designed so that each spherical ball that is dropped down the drill-string changes the direction of clean-out liquid flow either from the lower end of the liner to the upper end or from the upper end of the liner to the lower end of the liner. Hence, the number of times which this apparatus can be used to cycle fluid between the lower and upper ends of the liner is limited by the design of the device and when the spherical balls have been used or the tool is full with spherical balls and cannot be cyclically operated further, it is necessary to extract the drill-string from the borehole in order to recover the device and remove the spherical balls from the device.

In addition, there is also the danger that the spherical balls may not properly engage with the device and the risk that the device will not operate correctly.

In accordance with the present invention, there is provided apparatus for circulating fluid in a borehole, the apparatus having a fluid inlet and a first fluid outlet, the first fluid outlet communicating with the fluid inlet for throughflow of fluid through the apparatus, and the apparatus including:-

a body member having a second fluid outlet;

an isolation means movably mounted on the body member for movement between an open position in which fluid introduced into the apparatus through the fluid inlet may flow out of the second outlet, and a closed position in which fluid is substantially prevented from flowing out of the second outlet; and

actuating means connected with one of the body member or the isolation means for coupling to a formation in the borehole to provide resistance to movement of the actuating means with respect to the formation, whereby movement of the other of the body member or the isolation means relative to the formation causes relative movement between the isolation means and the body member to move the isolation means between its open and closed positions.

An advantage of the invention is that by providing an isolation means which is movable between a closed position and an open position and an actuating means which may be coupled to a formation in the borehole, circulation of fluid can be redirected by movement of one of the body member or isolation means relative to the formation.

Typically, the formation may be a shoulder portion in the borehole. Alternatively, the formation may be the bottom of the borehole, in which case the actuating means may be coupled to the formation by a string, such